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AIP report MANPOWER STATISTICS DIVISION

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1981–82 SURVEY OF PHYSICS AND ASTRONOMY BACHELOR'S DEGREE RECIPIENTS

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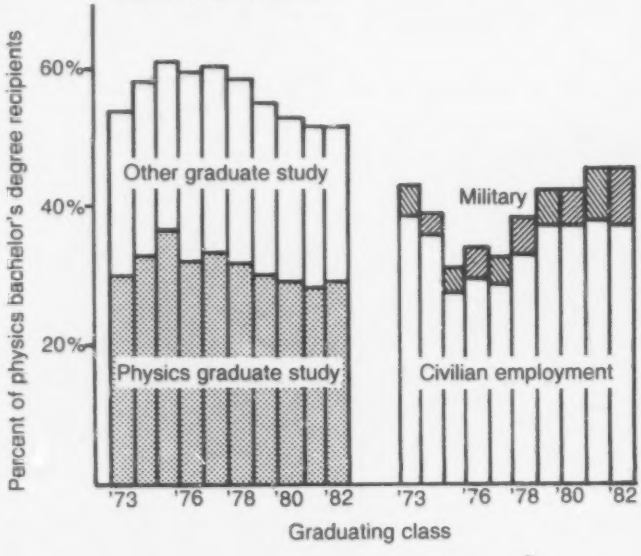
The graduating class of 1982 included 4558 physics and 181 astronomy bachelor's degree recipients from colleges and universities throughout the U.S. The information in this report comes from individual degree recipients and focuses on their postbaccalaureate plans. Highlights of this report are:

- –a further increase in the proportion of physics bachelors who enter the military
- –a very large proportion of physics bachelors who enter graduate physics programs are offered assistantships, and fewer than 10% of them need to resort to part-time employment or support from their families
- –the median starting salary for women physics bachelors rose by 12% in the most recent year

Figure I covers a ten-year period and reflects annual changes in postbaccalaureate plans of successive graduating classes of physics bachelors. There are two sets of bars, graduate study and employment, presenting four types of plans; physics graduate study is singled out from all the other disciplines physics bachelors enter, and civilian employment is being differentiated from military commitments. Not since the mid 1970's did major fluctuations in postbaccalaureate plans occur, and 1982 appears to have regained the approximate levels of ten years ago.

Figure I. Trend in postbaccalaureate plans of physics bachelors, 1973–82.



The numerical data for the bars in **Figure I** are presented in **Table I** from which we can identify a gradual increase in the proportion of physics bachelors who enter the military. This trend will be discussed in connection with **Tables VIII** and **X** which focus on initial employment.

Table I. Postbaccalaureate plans of successive graduating classes of physics bachelors, 1972–1982

Postbaccalaureate plans	1972–73	1973–74	1974–75	1975–76	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82
Physics graduate study	31%	34%	36%	32%	34%	33%	31%	30%	29%	30%
Other graduate study	24	25	27	28	28	26	24	24	24	23
Civilian employment	39	36	28	31	30	34	38	38	39	38
Military service	5	4	4	4	4	5	5	5	6	7
Undecided	1	1	5	5	4	2	2	3	2	2
Total number of physics bachelor's degrees	4923	4652	4571	4487	4517	4457	4416	4440	4513	4558

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Table II. Characteristics of new physics bachelors, 1981–82.

Characteristics	Postbaccalaureate plans: Graduate study: physics	other	Employment	Undecided	Total
Sex					
Female*	10%	11%	13%	21%	11.7%
Male	90	89	87	79	88.3
Citizenship					
U.S.	93%	92%	98%	92%	94.8%
Foreign	7	8	2	8	5.2
Age					
20 or younger	2%	1%	–	–	1.1%
21	7	6	4%	5%	5.3
22	51	54	39	48	45.6
23	20	22	24	26	22.2
24–27	14	12	21	19	17.0
28 and older	6	5	12	2	8.8
Minority groups					
U.S. blacks	0.8%	2.1%	2.4%	8.8%	2.0%
Other U.S. minorities	4.4	4.7	3.3	1.8	3.9
Foreign minorities	5.4	5.3	0.9	5.3	3.4
Double major					
Yes	28%	38%	25%	33%	29.9%
No	72	62	75	67	70.1
Type of undergraduate institution					
PhD-granting	59%	47%	45%	49%	47.8%
MS-granting	10	6	14	7	11.7
BS/BA-granting	31	47	41	44	40.5
Total number of bachelors	1355	1066	2033	104	4558
% distribution	30%	23%	45%	2%	100%
Number of respondents	737	580	1106	57	2480

**Percentage of women was adjusted for differential response rate*

By dividing the new physics bachelors according to their postbaccalaureate plans into three major groups and a small group of "undecided" graduates, the diversity of their background characteristics comes to light. For example, **Table II** indicates that slightly over 5% of the 1981–82 physics bachelors were foreign citizens. But examining the components of the composite group, we find that only 2% of the employment-oriented graduates were foreign, whereas between 7% and 8% of the bachelors headed for graduate study, were foreign. Similarly, age distributions of the bachelors differ significantly with respect to a group's postbaccalaureate plan. Only 43% of the employment-oriented graduates were 22 or younger, but among the prospective graduate students at least 60% fall into that age group. Another conspicuous characteristic presented in **Table II** is that bachelors who are interested in physics graduate study, are more likely to have begun their studies in a PhD-granting physics department than in a four-year college.

Studies dealing with occupational goals, have shown that the career aspirations of physicists can be traced to an earlier age for them than those of other professionals. Hence one might expect a consistently high proportion of physics graduates to have taken physics in high school. However, **Figure II**, which singles out the more dedicated physics students, indicates rising percentages of physics bachelors who had never taken physics before entering college. Back in 1970 only 4% fell into this category but by 1981 that group reached a high of 15% and a small decline to 13% can be observed as the class of 1982 is added to that trend.

Fig II. Physics bachelors, entering graduate physics departments who did not take high school physics, 1970–1981

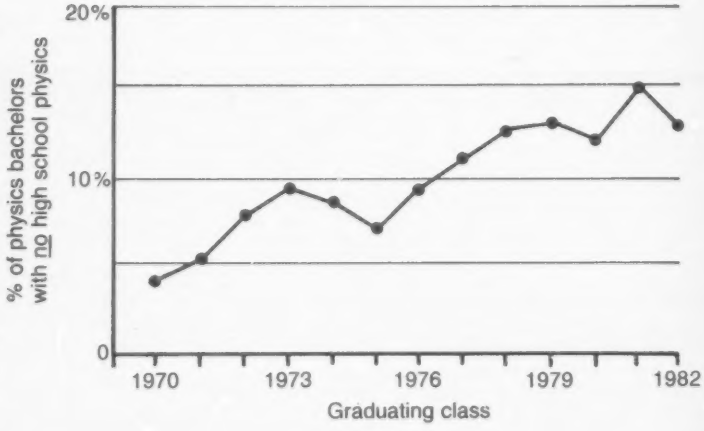


Table III. A comparison between men and women physics bachelors having taken high school physics.

Type of high school physics		Women	Men	Total %	N
PSSC*		23%	27%	26%	508
Project physics		10	14	13	259
Other		47	45	46	887
None		20	14	15	294
Total	%	100%	100%	100%	
Respondents	N**	274	1674		1948

** PSSC = Physical Science Study Committee*
***Nonrespondents to the question = 532*

Given the postdegree plans of the group on which **Figure II** is based, one can expect the percentage of all physics bachelors without exposure to high school physics, to be even higher; **Table III** confirms that expectation and furthermore shows that a smaller proportion of women took physics in high school.

Table IV. Postbaccalaureate plans of U.S. and foreign minorities among the physics bachelors of the class of 1982.

Minorities	Postbaccalaureate plans: Graduate study Physics	Other	Empl.	Total %	N
U.S.blacks	12%	24%	64%	100	53
U.S.Orientals	24	37	39	100	41
Other U.S.minorities	39	22	39	100	56
Total U.S.minorities	26	26	48	100	150
Foreign Orientals	52	36	12	100	33
Other foreign minorities	45	37	18	100	51
Total foreign minorities	48	37	15	100	84
All respondents	30	23	47	100	2480

Postbaccalaureate choices are influenced by several characteristics and citizenship is among the important ones. Therefore, when discussing the rising number of minority students, it becomes increasingly important to distinguish between U.S. and foreign minorities especially where employment plans are concerned. **Table IV** makes it clear that foreign minority graduates are more likely to enter graduate programs (85% of them) whereas only 52% of the combined U.S. minorities make those choices.

As mentioned in connection with **Table II**, a composite picture does not always reflect its component parts accurately, and the combined U.S. minorities are an example of that. **Table IV** shows that only 12% of black physics bachelors plan to enter physics graduate programs while twice that proportion of U.S. Orientals, and 39% of all other U.S. minorities do so. The groups that make up foreign minorities, on the other hand, appear to be more homogeneous in their postbaccalaureate choices. **Table IV** also compares both U.S. and foreign minorities with all responding physics bachelors pointing, on the one hand, to the difference that citizenship makes, and on the other hand, showing how similar the plans of "Total U.S. minorities" are to those of all respondents.

More detailed characteristics of seven distinct minority groups are presented in **Table V**; they include the types of physics departments, their geographic location in the U.S., and the distribution of men and women in each group. As in **Tables II** and **IV** the larger minority groups are divided into U.S. and foreign. Noteworthy among the characteristics is the large proportion of women among U.S. blacks and that group's concentration in the four-year colleges. Orientals, irrespective of citizenship, appear to choose institutions on the West Coast and the Northeast while Hispanics are more evenly distributed throughout the U.S.

Table V. Selected characteristics of minority physics bacheiors, 1982

		Minority group: Black U.S.	Black Foreign	Mexican American	American Indian	Hispanic U.S.	Hispanic Foreign	Oriental U.S.	Oriental Foreign	Indian	Arab
Total		53	12	16	6	16	9	45	34	8	42
Sex	Female	17	–	2	–	2	–	5	8	–	4
	Male	36	12	14	6	14	9	40	26	8	38
*Region of bach's inst.	Northeast	7	4	3	1	5	3	14	11	3	14
	Southeast	26	4	1	1	5	2	5	3	1	7
	Central & Mountain	17	3	5	3	4	2	8	8	4	15
	Pacific	3	1	7	1	2	2	18	12	–	6
Type of bach's inst.	PhD-granting	10	1	5	1	6	2	31	19	3	19
	MS-granting	10	2	3	1	2	3	2	3	–	4
	BS/BA-granting	33	9	8	4	8	4	12	12	5	19

**Regions: Northeast = New England, Middle Atlantic; Southeast = South Atlantic, East South Central; Central = East North Central, West North Central, West South Central.*

Table VI. Sources of anticipated support for first-year graduate study*, 1980 to 1982.

Sources of support	Students planning: Physics graduate study			Other graduate study		
	1980	1981	1982	1980	1981	1982
Teaching assistantship	71%	67%	64%	26%	28%	26%
Research assistantship	12	14	15	24	18	20
Fellowship	10	10	12	12	13	15
Employment (part-time)	3	4	3	12	15	13
Family, savings, loan	2	4	4	23	21	23
Other	2	1	2	3	5	3
	100%	100%	100%	100%	100%	100%
Graduate study status: full-time	94	94	94	90	86	88
Graduate study status: part-time	6	6	6	10	14	12
Total number of full-time students	1332	1327	1355	1066	1079	1066

**The information was reported for September of each academic year.*

In the reports of previous years, **Table VI** focused on prospective graduate students who intended to pursue their graduate studies exclusive of other major commitments. The lower portion of this year's table includes physics bachelors who have accepted full-time employment and pursue a graduate degree on a part-time basis. In physics only 6% of the first-year graduate students fall into that category, whereas 10% to 14% of the physics bachelors who entered "other graduate study," reported part-time graduate work.

Concentrating on the full-time students, it is clear from **Table VI** that the sources of support differ for the first-year physics students from those who selected other disciplines for graduate study. The physics students are much more likely to be offered teaching assistantships and fewer than 10% of them need to resort to part-time employment or support from their families. Choosing a non-physics area, on the other hand, makes the assurance of an assistantship less likely and the use of personal funds were reported by more than one-third of those first-year students in recent years.

Assessing the demand for new physics bachelors is a complex task, but asking the employment-oriented graduates for the number of job offers each received, serves as a good approximation of that assessment. **Table VII** indicates a generally improving employment market throughout the 1970's followed by a recent tightening trend in the early 1980's. Since 1979 the proportion of graduates who received multiple offers to choose from, declined by one-third.

Although postbaccalaureate plans have been discussed in connection with the earlier figure and tables, the flow diagram of **Figure III** offers unique details. Since the demand for physics bachelors can change from year to year, it is important to interpret the survey responses carefully before formulating a picture of what the circumstances were in the summer of 1982. The proportion of graduates with employment plans was identical to that of the previous year, but several significant changes occurred within that group. The outstanding change was the decline in the group of graduates who were "not yet seeking employment" from 7% to 1% which in turn effected changes in the group still seeking employment. The general three percentage-point shift from those who were "Uncommitted" to those who were "Employed" would indicate an improvement in employment opportunities; but whenever more graduates feel

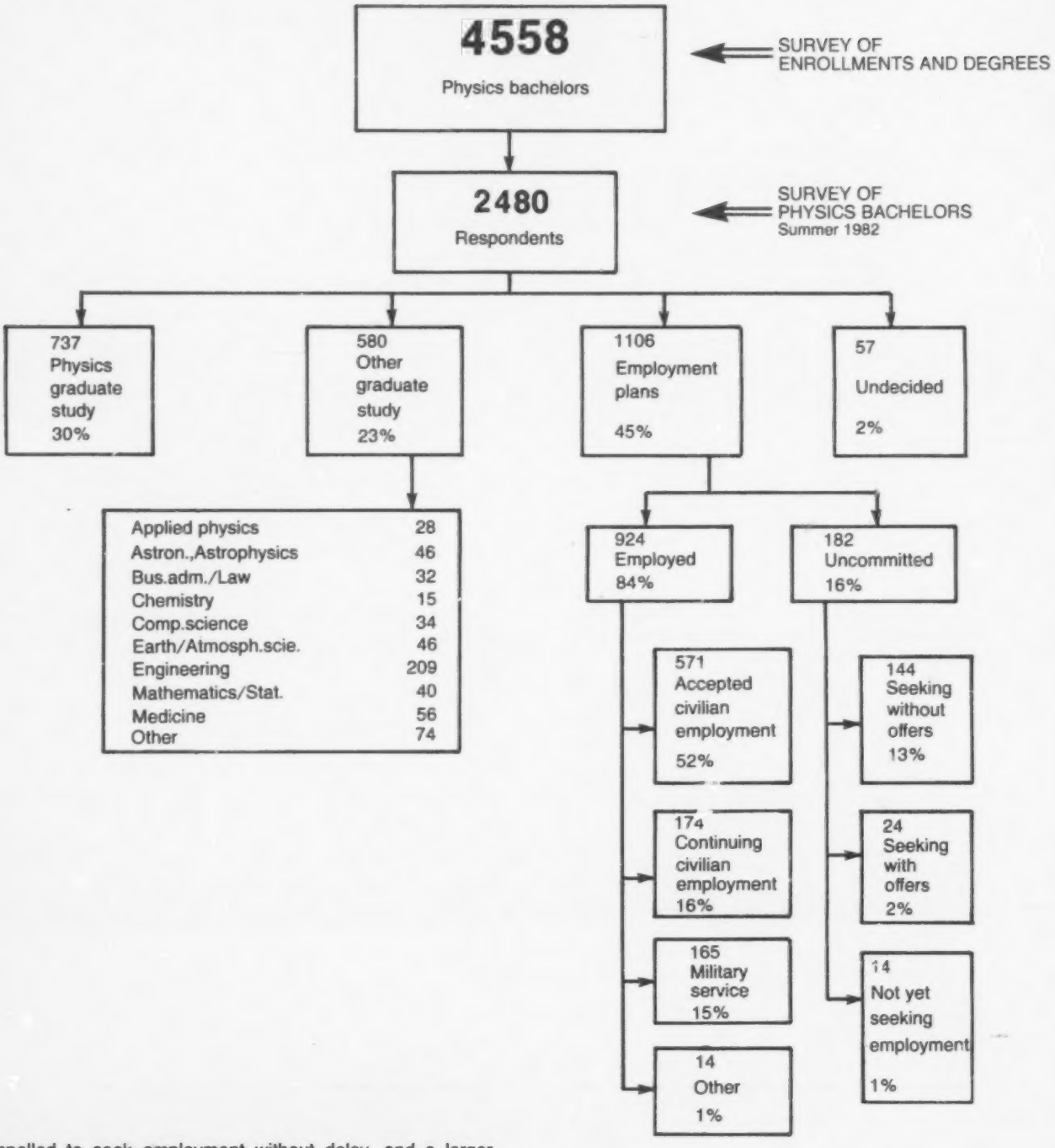
Table VII. Changes in employment outlook for new physics bachelors, 1973 to 1982.

Numbers of job offers at graduation	Summer 1973	Summer 1975*	Summer 1977	Summer 1979	Summer 1980	Summer 1981	Summer 1982
0	26%	17%	11%	9%	10%	10%	13%
1**	50	56	52	46	50	55	57
2 or more	24	27	37	45	40	35	30

**These figures have been revised from those presented in earlier reports to include military commitments.*

***Bachelors who enter the military service are included here.*

Fig. III. Postbaccalaureate plans of physics bachelors of the class of 1982.



compelled to seek employment without delay, and a larger proportion of graduates enter the military, a tightened job market is usually the cause.

Figure III also specifies the nine most frequently mentioned areas of "Other graduate study" that physics bachelors of the class of 1982 have chosen. Engineering continues to be the largest as medicine registers a decline from the previous year.

Table VIII. Initial employment of physics bachelors, 1975–1982

Type of employer		Percentage of employed bachelors						
		1975–76	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82
Industry	manufacture	30%	32%	37%	40%	41%	40%	38%
	service	19	16	21	18	20	22	22
High school		11	8	7	6	3	2	3
College or univ.		4	5	3	4	3	4	4
Government	civilian employ.	10	7	7	7	8	7	7
	career military	13	12	14	15	16	21	24
Other		13	20	11	10	9	4	2
Total		100%	100%	100%	100%	100%	100%	100%

Table IX. Starting salaries of physics bachelors, 1982.

Type of employer	Men (502 reported salaries)		Women (98 reported salaries)		Total (600 reported salaries)	
	Dist. by employer	Median monthly salary	Dist. by employer	Median monthly salary	Dist. by employer	Median monthly salary
Industry-manuf.	36%	$ 2 020	45%	$2 020	38%	$2 020
Industry-service	21	1 920	24	1 830	22	1 900
High school	3	1 060	4	*	3	1 050
Coll/Univ.	4	1 300	3	*	4	1 300
Government Civilian	5	1 375	8	2 050	5	1 400
Government Military	27	1 360	12	1 350	24	1 360
FFRC	2	1 800	2	1 950	2	1 850
Other	2	*	2	*	2	*
Total	100%	$1 680	100%	$1 855	100%	$1 710

**Insufficient data*

Tables VIII through **X** focus on the employment-oriented bachelors by presenting details concerning the types of employers, work activities and starting salaries. Going back to the mid 1970's, **Table VIII** traces the types of employers who engaged new physics bachelors. Graduates who continued in positions they have held while completing their college degrees, are not included in **Tables VIII** and **IX**. Thus **Table VIII** shows how the economic prospects industry offers, have attracted a majority of new physics bachelors for several years, while the need for physics teachers by secondary schools is not eliciting much response. Another employer which has offered a diversity of careers to new physics bachelors is the military, and **Table VIII** indicates the growing attraction military service has represented over the past seven years. In fact additional training funded by the military as well as job security are among the fringe benefits which compensate new graduates for the low salaries. **Table IX** substantiates that statement by listing the median monthly starting salaries for major employers of physics bachelors, and shows that military salaries are 20% below the median.

Since nearly one hundred women graduates reported their salaries, it seemed appropriate to present separate medians for men and women in **Table IX**, and they are $1680.— and $1855.— respectively. The reason for so great a difference in salaries between men and women is the higher proportion of men in the military. Were we to exclude those 27% with military commitments, the median salary for men would be $1890.—per month.

In comparison with the previous year, the combined salaries for men and women increased only 3%, but those paid only to women rose 12%. The explanation for this increase can be found both in the higher proportion of men who join the military, and in examination of industrial and civilian government salaries. Unlike the 1981 salaries, in 1982 men and women who had accepted industrial (manufacture) employment, reported the same median starting salaries; and civilian government positions, though they were reported by only a small number of graduates, generally paid higher starting salaries to women than to men.

Table X. Full-time employment* of new physics bachelors, 1982.

Work activity	Industry manufacture	Industry service	High school	Government civilian	Government military	Coll/ univ.	Other	Total N	Total %
Teaching	2	–	22	11	2	5	4	46	5
Res.& dev.	72	29	–	5	18	12	11	147	16
Dev.& design	106	26	–	5	7	4	5	153	17
Programming	87	91	–	12	7	10	12	219	24
Quality control	64	30	–	10	1	7	8	120	13
Pilot/navigator training	2	–	–	–	71	–	–	73	8
Nuclear power school	–	2	–	–	39	–	1	42	5
Other prof. work	12	15	–	8	7	2	6	50	5
Other	12	14	–	9	13	3	9	60	7
Total N	357	207	22	60	165	43	56	910	
Total %	39%	23%	2%	7%	18%	5%	6%		100%

**The employment of these 910 graduates includes both newly accepted positions as well as those in which graduates are continuing.*

Table X shows a slightly different distribution of major employers than the ones shown in **Tables VIII** and **IX**. Since **Table X** includes 174 graduating bachelors who continued the civilian employment they held as undergraduates, military service comprises a smaller percentage and industry a larger one for this group. The work activities are arranged with a view toward the graduate's use of his or her physics training; thus teaching and research and development are listed first, indicating work activities which make extensive use of undergraduate physics training. Development and design refer largely to engineering positions, while programming work appears to attract an increasing proportion of physics bachelors from year to year.

In recent years, we noticed that few of the work activities listed on our questionnaires matched the programs outlined by the military. But for the 1982 graduates, the list was amended to include pilot, or navigator training and nuclear power school which evidently applied to a fair number of graduates.

ASTRONOMY

Table XI. Postbaccalaureate plans of successive graduating classes of astronomy bachelors, 1975–1982.

Postbaccalaureate plans	1975–76	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82
Astronomy graduate study	46%	28%	33%	28%	35%	24%	29%
Other graduate study	29	27	22	19	17	13	25
Employment	20	33	40	51	43	59	45
Undecided	5	12	5	2	5	4	1
Total number of astronomy bachelors	172	184	177	165	165	156	181

Both the number of astronomy bachelor's degrees and the responses from individual graduates have risen significantly between 1981 and 1982; nevertheless, the numbers involved are small compared with physics and consequently the postbaccalaureate plans presented in **Table XI** fluctuate rather widely. Looking back at the mid 1970's, a decided shift toward employment and away from graduate studies appears to have occurred, but year-to-year changes are difficult to explain.

Among the 106 responding astronomy bachelors, only one graduate was undecided about her postbaccalaureate plans, hence **Table XII** presents characteristics of only three groups. Almost half of the astronomy bachelors (49%) graduate with a double major, and for most of them the other major is physics. Foreign students and minority groups comprise very small proportions among the astronomy undergraduates, but women constitute a growing percentage, up six percentage-points from the previous year. Nonrespondents to specific questions such as "type of high school physics" account for differences between the numbers shown in **Table XII** and the total numbers at the bottom of the columns for the three postbaccalaureate plans.

Table XII. Characteristics of astronomy bachelors, 1982.

Characteristics		Postbaccalaureate plans: Graduate study — Astronomy N	Other N	Employment N	Total %
Sex	Female	6	11	10	25%
	Male	25	16	37	75
Citizenship	U.S.	30	26	47	98%
	Foreign	1	1	–	2
Type of high school physics	PSSC	2	7	6	16%
	Project physics	5	4	9	19
	Other	16	13	20	55
	None	3	2	4	10
Age	21 or younger	3	2	–	5%
	22 yrs.	18	19	26	57
	23 yrs.	6	5	11	23
	24 or older	4	1	10	15
Type of bachelor's institution	PhD-granting	26	23	35	80%
	MS-granting	1	1	4	6
	BS/BA-granting	4	3	8	14
Type of degree	Science	15	16	33	63%
	Arts	14	11	14	37
Double major	with physics	13	10	15	38%
	with mathematics	2	2	2	6
	with other	–	3	2	5
Total respondents		31	27	47	105

Fig. IV. Postbaccalaureate plans of astronomy bachelors of the class of 1982.

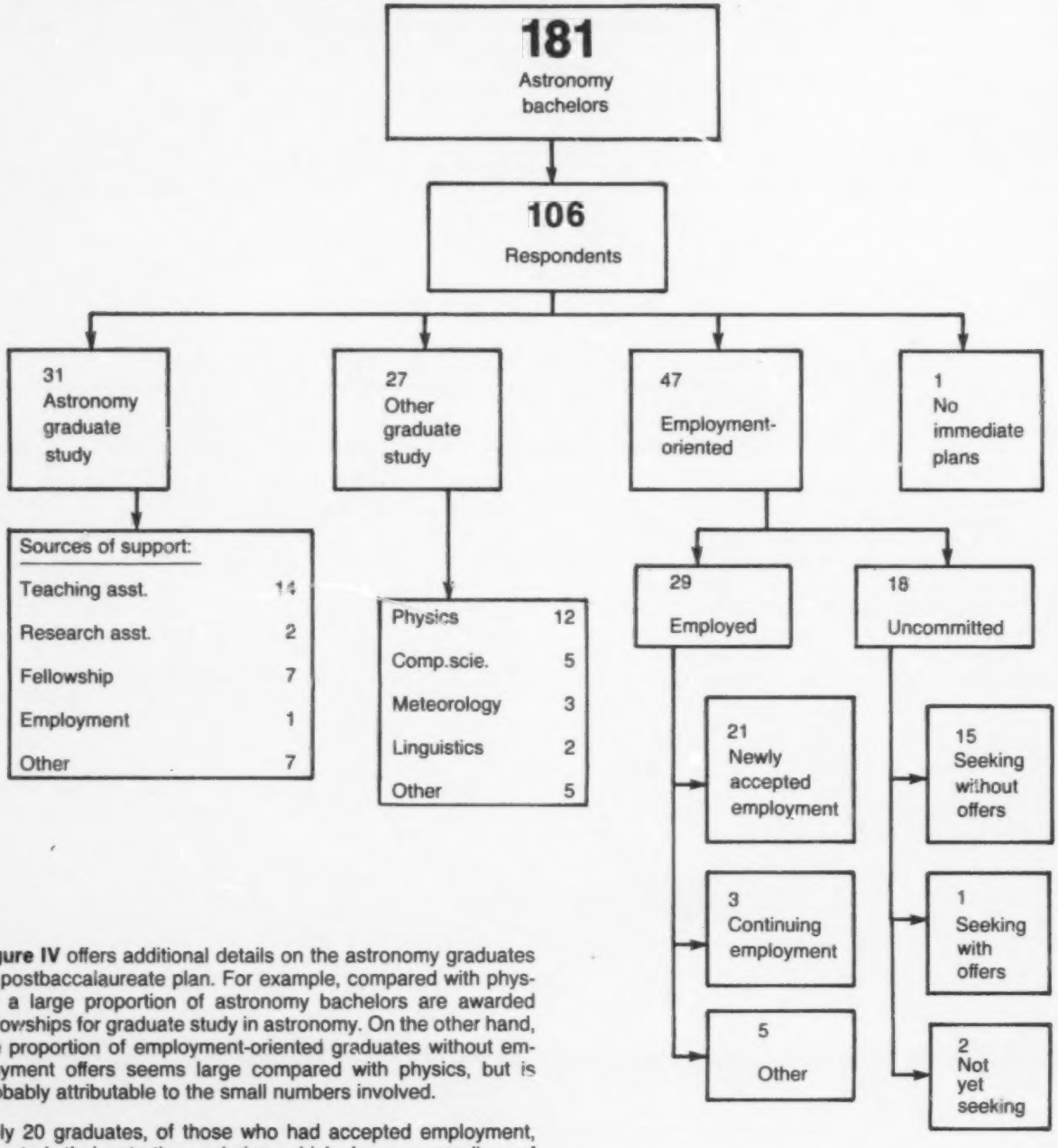


Figure IV offers additional details on the astronomy graduates by postbaccalaureate plan. For example, compared with physics a large proportion of astronomy bachelors are awarded fellowships for graduate study in astronomy. On the other hand, the proportion of employment-oriented graduates without employment offers seems large compared with physics, but is probably attributable to the small numbers involved.

Only 20 graduates, of those who had accepted employment, reported their starting salaries which have a median of $1500.—per month. Unlike previous years, fewer bachelors found employment in industry and more of them started work with different branches of the government. Only two of the graduates accepted teaching positions in secondary schools.